Prevalence and Readability of Advertisements Among Highest Search Engine Results for Pediatric Dental Search Terms

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Introduction

A common source of supplemental medical information for patients and parents is the internet. Google, the most popular search engine worldwide, is frequently utilized to search for online articles related to keywords of interest relevant to their health conditions. Patients often rely on these resources to help them make informed decisions about their care, facilitate their understanding of a disease or planned procedure, and increase their knowledge base to expand the dialogue between them and their providers.[1]

In an effort to increase traffic to websites advertising businesses and products from people using search engines, the practice of Search Engine Optimization (SEO) was developed. SEO is an internet marketing strategy that involves understanding how search engine algorithms determine the order in which webpages are presented. This knowledge is used to maximize visibility of a webpage through strategic design in order to advertise to a target audience for key search terms.[2] With the advent of SEO, there is the potential for a significant proportion of the websites that rank highest on the search engine results page to be advertisements directing visitors to businesses that market products or services. While the information presented on advertising websites are generally factual and presented in an easily readable format, the information often tends to be simplified and lack peer review.[3,4] By saturating the first several pages of search results with advertisements, SEO could limit patients' access to higher quality sources such as research journal articles that present unbiased, evidence-based information.[5]

The purpose of this project is to evaluate the prevalence of advertisements among the highest Google search results of common search terms related to pediatric dentistry. We also seek to compare the readability of advertisements to other webpages among the highest results to gain insight into the accessibility of advertisements in relation to other online forms of media. Finally, we compare the readability of webpages to their page number on the search engine results to assess accessibility of first-page results compared to other search results.

Methods

Sample: Google AdWords was employed to identify 53 pediatric dental search terms with high search rates. These search terms were divided into the categories of prevention, diagnosis, emergency treatment, restorative treatment, conservative treatment, sedation, and oral habits. The top 20 webpage results meeting the inclusion/exclusion criteria were recorded for each search term yielding a total of 1,060 webpages.

Design: Inclusion criteria were webpages containing at least 200 words, the minimum length sufficient for a readability analysis. Exclusion criteria were links to video hosting websites as the study focused on text-based web pages. Webpages repeatedly generated from the results of similar search terms were not excluded from the analysis.

Procedures: Each search term was entered into the Google search engine while operating Google Chrome browser in Incognito Mode with cleared cookies to minimize influences from tracking of previous website activity on generated search terms. A text sample of 200-700 words from each webpage was collected to calculate readability using four validated formulae: Flesch-Kincaid, Gunning Fog Index, SMOG Index, and Dale-Chall. Grade levels were additionally calculated for the Flesch-Kincaid and Dale-Chall values corresponding to the estimated minimum grade level of U.S. formal education necessary to fully comprehend the text. The webpages were additionally sorted into advertisement and non-advertisement sources. A webpage was determined to be an advertisement if it provided links directly marketing a service or product, excluding subscriptions to online scientific journal access. The search engine result page (SERP) of each webpage was recorded

Measures: An analysis was performed comparing the readability of advertising webpages to other webpages. The proportion of advertisements among first-page search results was observed. The readability of each webpage was also compared to the SERP.

Statistical Analysis: A linear mixed model was employed to analyze the results. Readability data were log-transformed to normalize the heavy right-skewed results.

Results

- Overall, 48.4% of the top 20 search results consisted of advertisements, while 42.1% of first-page results consisted of advertisements
- Proportions of first-page advertisements ranged from 0% for "Cvek Pulpotomies", "Abscess Tooth", and "Formocresol Pulpotomy" to 88.9% for "White Fillings" and "Silver Crown Tooth"
- Flesch-Kincaid Grade Levels increased significantly (p = 0.029), with average Flesch-Kincaid readability scores increasing by 2.3% per additional search result page
- Average Gunning-Fog readability scores increased, but the results were not statistically significant (p = 0.125). Average Gunning Fog readability scores increased by 1.5% per additional results page
- Average SMOG reading levels increased significantly (p = 0.042), with an increase of 1.9% per additional search result page
- Average Dale-Chall Grade Levels increased significantly (p = 0.042), with an increase of 1.4% per additional search result page
- Average F-K GLs were significantly lower (p = 0.0001) when comparing advertisements to non-advertisements (9.8 vs. 10.6)
- Average G-F readability scores were significantly lower (p < 0.0001) when comparing advertisements to non-advertisements (12.3 vs. 13.6)
- Average SMOG reading levels were significantly lower (p < 0.0001) when comparing advertisements to non-advertisements (9.0 vs. 9.7)
- Average D-C GLs were significantly lower (p < 0.0001) when comparing advertisements to non-advertisements (7.9 vs. 8.4)

Percentage of Advertisements Overall and Among First-Page Search Results

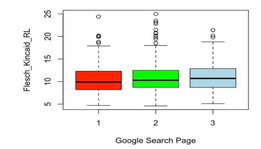
Advertisement	Yes	No
Overall Count (%)	513 (48.4%)	547 (51.6%)

Advertisement	Yes	No
Page 1 Count (%)	189 (42.1%)	260 (57.9%)

Reading Level by Search Page

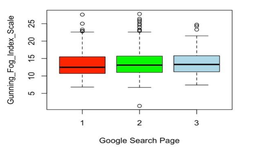
Measure	Page 1 (*n* = 449)	Page 2 (*n* = 413)	Page 3 (*n* = 198)
Mean ± SD	10.5 ± 3.1	10.9 ± 3.3	11.0 ± 3.2
Median (IQR)	9.9 (8.2 to 12.3)	10.3 (8.7 to 12.5)	10.7 (8.7 to 12.9)

F-K Index vs. Search Page



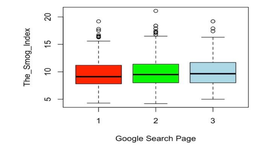
Measure	Page 1 (*n* = 449)	Page 2 (*n* = 413)	Page 3 (*n* = 198)
Mean ± SD	13.3 ± 3.6	13.6 ± 3.8	13.7 ± 3.7
Median (IQR)	12.5 (10.7 to 15.5)	13.1 (11.0 to 15.7)	13.3 (11.2 to 15.8)

GFI Index vs. Search Page



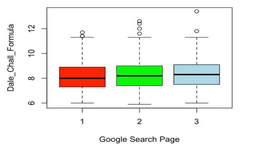
Measure	Page 1 (*n* = 449)	Page 2 (*n* = 413)	Page 3 (*n* = 198)
Mean ± SD	9.6 ± 2.6	9.9 ± 2.8	10.0 ± 2.7
Median (IQR)	9.1 (7.8 to 11.2)	9.5 (8.0 to 11.4)	9.7 (8.0 to 11.7)

SMOG Index vs. Search Page



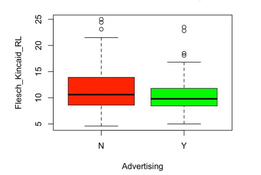
Measure	Page 1 (*n* = 449)	Page 2 (*n* = 413)	Page 3 (*n* = 198)
Mean ± SD	8.2 ± 1.1	8.3 ± 1.2	8.4 ± 1.2
Median (IQR)	8.0 (7.3 to 8.9)	8.2 (7.4 to 9.0)	8.3 (7.5 to 9.1)

Dale-Chall Index vs. Search Page

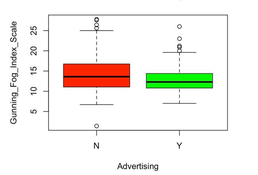


Reading Level With and Without Advertisements

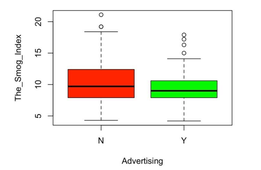
F-K Index vs. Advertising



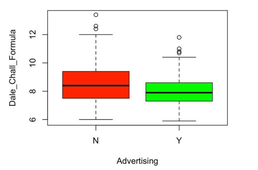
GFI vs. Advertising



SMOG Index vs. Advertising



Dale-Chall Index vs. Advertising



Conclusions

- Reading levels of advertisement links were lower than non-advertisement links, indicating the overall greater accessibility of information included in advertisements
- Reading levels increased as page number increased, indicating greater accessibility of first-page search results
- All webpages were at or above the 6th Grade reading level recommended by the APPD
- Average overall reading levels were 10.8 (Flesch-Kincaid), 13.5 (Gunning-Fog), 9.8 (SMOG), and 8.2 (Dale-Chall), which are well above the recommended reading level. This suggests that improvements can be made to how information-based webpages are written to increase reader comprehension and accessibility

References

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3. Park, Sung-Yeon, et al. "US Direct-to-Consumer Medical Service Advertisements Fail to Provide Adequate Information on Quality and Cost of Care." Journal of Medical Ethics, vol. 47, no. 12, 2020, https://doi.org/10.1136/medethics-2020-106458. Reading levels increased as page number increased, indicating greater accessibility of first-page search results
4. Walther, Joseph B, et al. "The Effect of Top-Level Domains and Advertisements on Health Web Site Credibility." Journal of Medical Internet Research, vol. 6, no. 3, 2004, https://doi.org/10.2196/jmir.6.3.e24.
5. Garfinkle, R., et al. "Assessing the Readability, Quality and Accuracy of Online Health Information for Patients with Low Anterior Resection Syndrome Following Surgery for Rectal Cancer." Colorectal Disease, vol. 21, no. 5, 2019, pp. 523–531., https://doi.org/10.1111/codi.14548.